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Groundwater Vulnerability to Seawater Intrusion along Coastal Urban Areas: A Quantitative Comparative Assessment of EPIK and DRASTIC

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Groundwater vulnerability assessment models are invariably coupled with Geographic Information Systems to provide decision makers with easier visualization of complex systems. In this study, we examine the uncertainty associated with such models (DRASTIC, EPIK) in assessing seawater intrusion, a growing threat along coastal urban cities due to overexploitation of groundwater resources associated with population growth and more recently, exacerbated by climate change impacts. For this purpose, a mapping of groundwater vulnerability was first conducted at a country level (Lebanon) and coupled with a groundwater quality monitoring program in three coastal cities for cross-validation. Then, six water quality categories were defined and mapped based on water quality standards ranging from drinking to seawater with weighted scores assigned for each category in both DRASTIC and EPIK for cross-validation. Finally, the results of groundwater quality tests were compared with vulnerability predictions at sampling points using two indicators (Chloride and TDS). While field measurements demonstrated the high vulnerability to seawater intrusion in coastal urbanized areas, the modelling results exhibited variations from field measurements reaching up to two water quality categories. Vertical-based vulnerability models demonstrated poor correlation when the anthropogenic impact was introduced through a process that depends on lateral groundwater flow thus highlighting (1) the limited ability of such models to capture vulnerability to lateral seawater intrusion induced primarily by vertical groundwater withdrawal, and (2) the need to incorporate depth and underlying lithology into the layers of groundwater vulnerability models when examining horizontally induced contamination such as seawater intrusion.